

Table S1: The 12 CMIP6 models and variants that were dynamically downscaled

Modeling center	Model	Variant
Commonwealth Scientific and Industrial Research Organisation, Australia	ACCESS-CM2	r5i1p1f1
Canadian Centre for Climate Modelling and Analysis, Canada	CanESM5	r1i1p2f1
National Center for Atmospheric Research, USA	CESM2	r1i1p1f1
Centre National de Recherches Meteorologiques, France	CNRM-ESM2-1	r1i1p1f2
EC-Earth consortium, Sweden	EC-Earth3	r1i1p1f1
EC-Earth consortium, Sweden	EC-Earth3-Veg	r1i1p1f1
Chinese Academy of Sciences, China	FGOALS-g3	r1i1p1f1
Japan Agency for Marine-Earth Science and Technology, Japan	MIROC6	r1i1p1f1
Max Planck Institute for Meteorology, Germany	MPI-ESM1-2-HR	r3i1p1f1
Max Planck Institute for Meteorology, Germany	MPI-ESM1-2-LR	r7i1p1f1
Research Center for Environmental Changes, Taiwan	TaiESM1	r1i1p1f1
Met Office Hadley Centre, UK	UKESM1-0-LL	r2i1p1f2

Table S2: The 34 CMIP6 models used for statistically downscaled projections in Fig. 5

Modeling center	Model	Variant
Commonwealth Scientific and Industrial Research Organisation, Australia	ACCESS-CM2	r5i1p1f1
Commonwealth Scientific and Industrial Research Organisation, Australia	ACCESS-ESM1-5	r1i1p1f1
Alfred Wegener Institute, Germany	AWI-CM-1-1-MR	r1i1p1f1
Beijing Climate Center, China	BCC-CSM2-MR	r1i1p1f1
Chinese Academy of Meteorological Sciences, China	CAMS-CSM1-0	r1i1p1f1
Canadian Centre for Climate Modelling and Analysis, Canada	CanESM5	r1i1p2f1
Chinese Academy of Sciences, China	CAS-ESM2-0	r1i1p1f1
National Center for Atmospheric Research, USA	CESM2	r1i1p1f1
National Center for Atmospheric Research, USA	CESM2-WACCM	r1i1p1f1
Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici, Italy	CMCC-CM2-SR5	r1i1p1f1
Centre National de Recherches Meteorologiques, France	CNRM-CM6-1	r1i1p1f2
Centre National de Recherches Meteorologiques, France	CNRM-ESM2-1	r1i1p1f2
EC-Earth consortium, Sweden	EC-Earth3	r1i1p1f1
EC-Earth consortium, Sweden	EC-Earth3-Veg	r1i1p1f1
Chinese Academy of Sciences, China	FGOALS-f3-L	r1i1p1f1
Chinese Academy of Sciences, China	FGOALS-g3	r1i1p1f1
National Oceanic and Atmospheric Administration, USA	GFDL-ESM4	r1i1p1f1
Goddard Institute for Space Studies, USA	GISS-E2-1-G	r1i1p1f2
Goddard Institute for Space Studies, USA	GISS-E2-1-H	r1i1p1f2
Indian Institute of Tropical Meteorology, India	IITM-ESM	r1i1p1f1
Institute for Numerical Mathematics, Russia	INM-CM4-8	r1i1p1f1
Institute for Numerical Mathematics, Russia	INM-CM5-0	r1i1p1f1
Institut Pierre Simon Laplace, France	IPSL-CM6A-LR	r1i1p1f1
Korea Meteorological Administration, South Korea	KACE-1-0-G	r1i1p1f1
University of Arizona, USA	MCM-UA-1-0	r1i1p1f2
Japan Agency for Marine-Earth Science and Technology, Japan	MIROC6	r1i1p1f1
Japan Agency for Marine-Earth Science and Technology, Japan	MIROC-ES2L	r1i1p1f2
Max Planck Institute for Meteorology, Germany	MPI-ESM1-2-HR	r3i1p1f1
Max Planck Institute for Meteorology, Germany	MPI-ESM1-2-LR	r7i1p1f1
Meteorological Research Institute, Japan	MRI-ESM2-0	r1i1p1f1
Norwegian Climate Center, Norway	NorESM2-LM	r1i1p1f1
Norwegian Climate Center, Norway	NorESM2-MM	r1i1p1f1
Research Center for Environmental Changes, Taiwan	TaiESM1	r1i1p1f1
Met Office Hadley Centre, UK	UKESM1-0-LL	r2i1p1f2

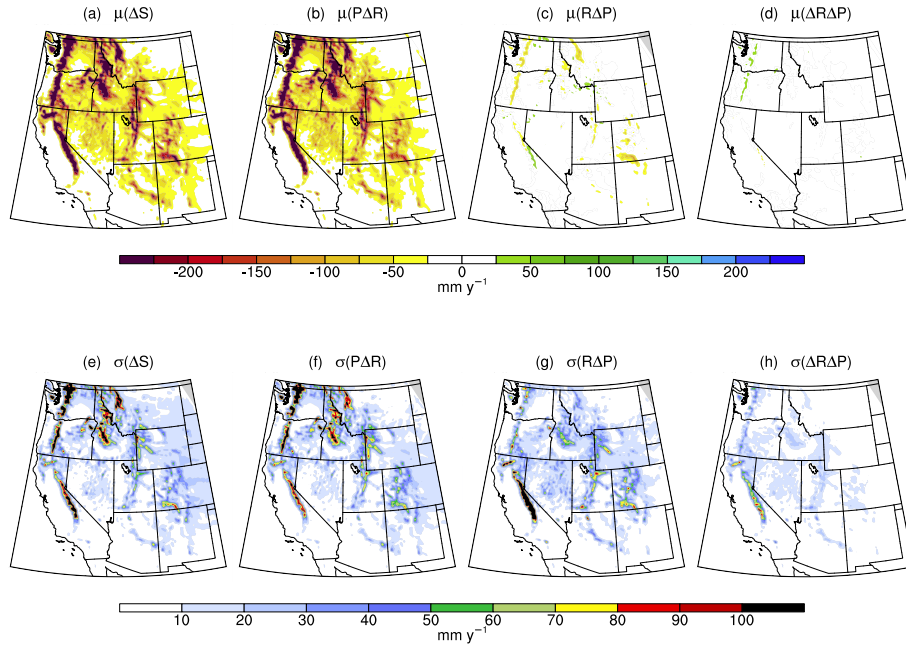


Figure S1: As Fig. 2 but including the second-order term $\Delta R\Delta P$.

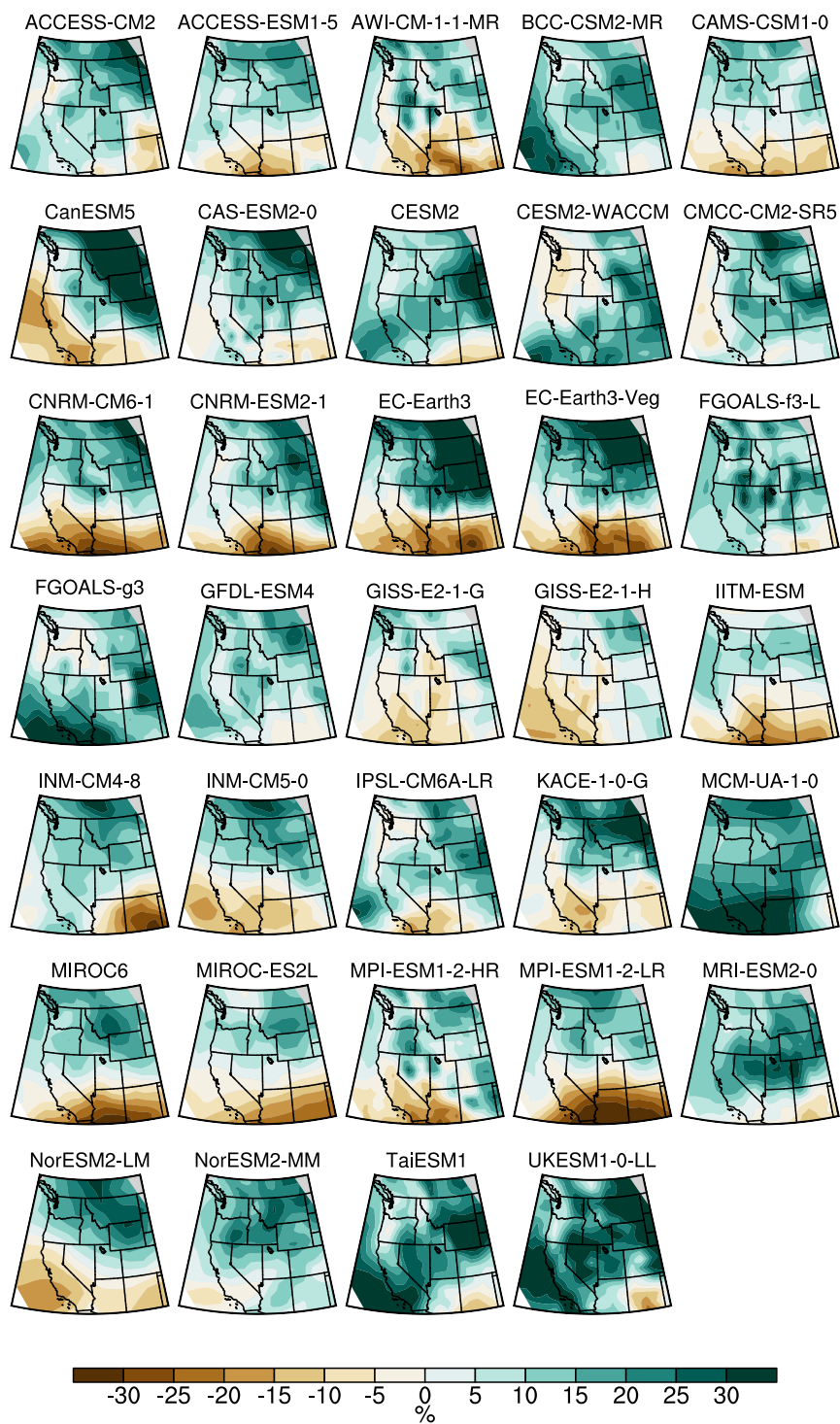


Figure S2: $\Delta P/P$ in NDJFMA in all 34 CMIP6 GCMs.

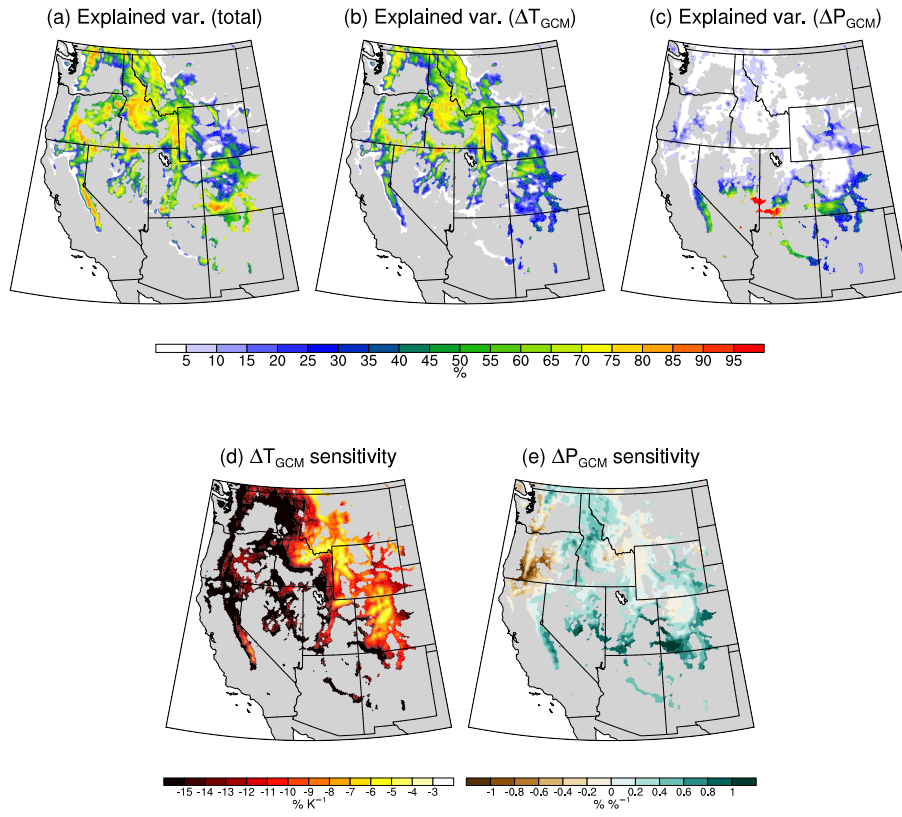


Figure S3: As Fig. 4, but using global-mean, instead of local, ΔT_{GCM} .

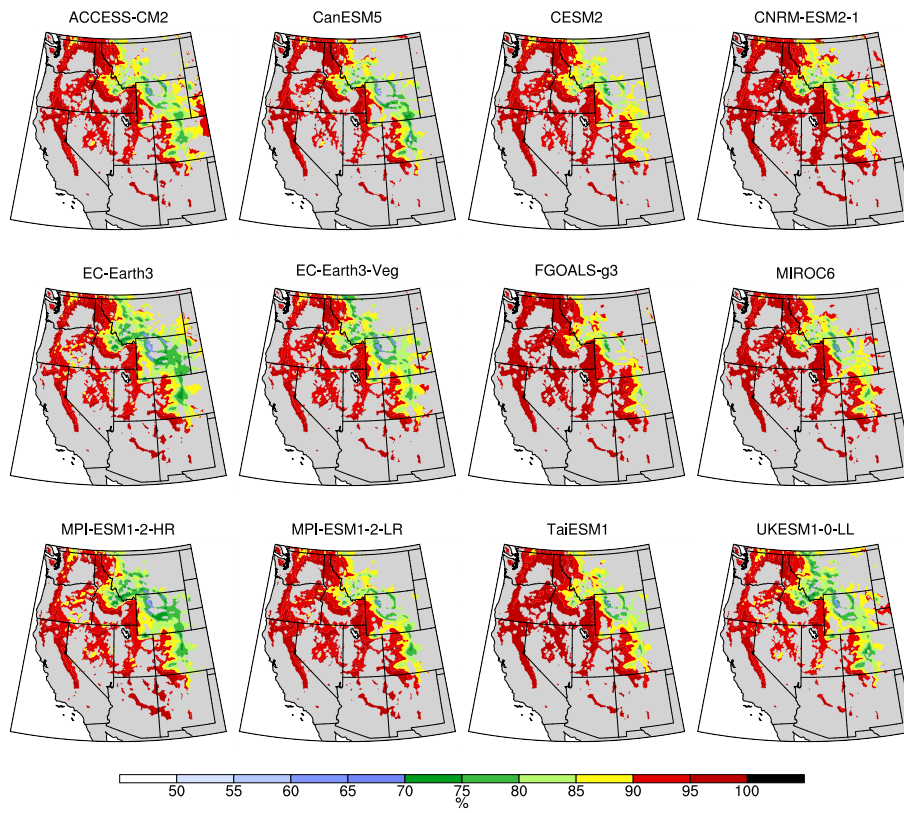


Figure S4: The percentage of annual historical snow falling in NDJFMA in each downscaled GCM.

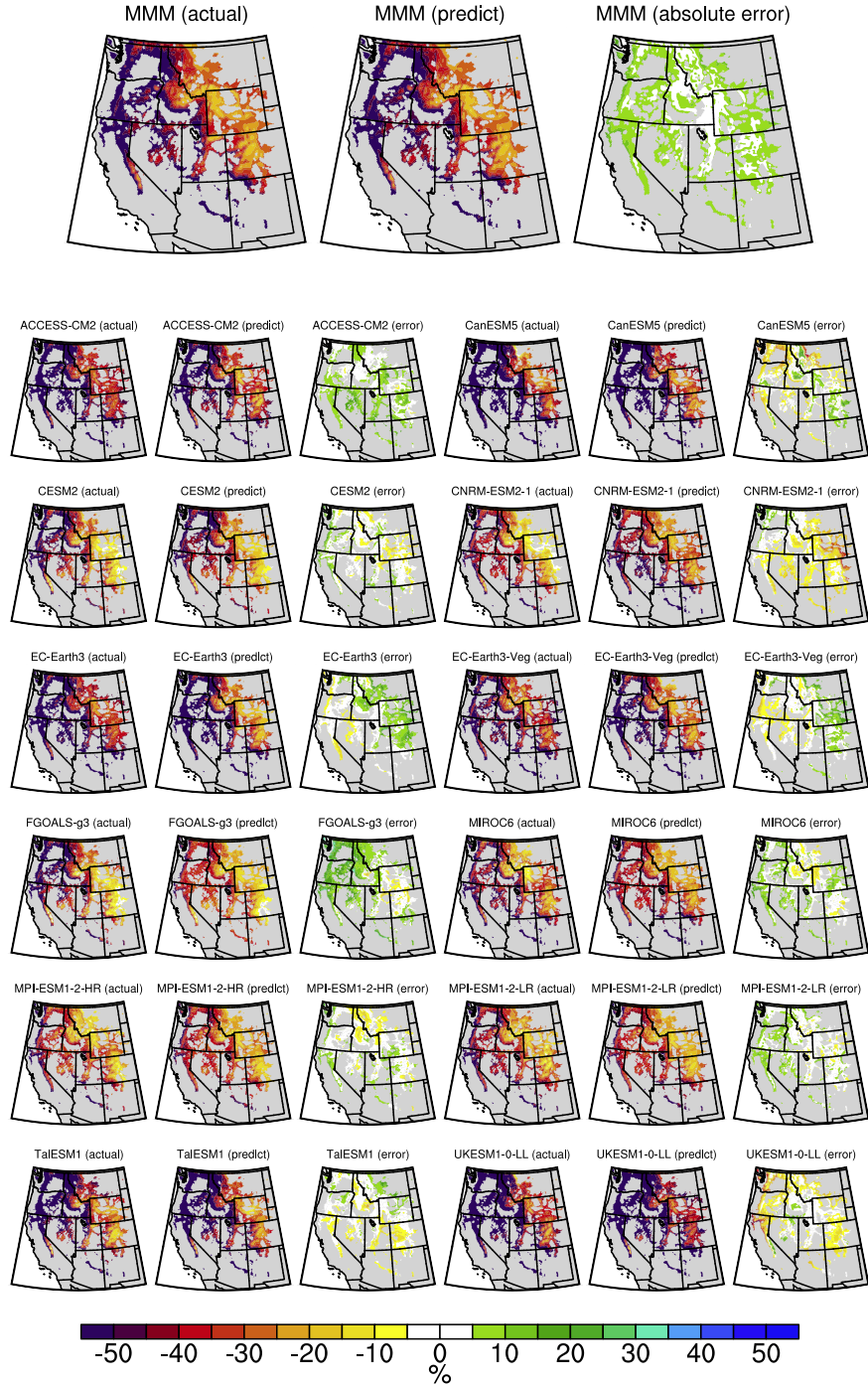


Figure S5: A leave-one-out validation of the multi-linear regression model (Equation 3). The regression is repeated 12 times, omitting each GCM in turn. Then the snowfall loss predicted by the regression is compared to the actual snowfall loss simulated by the given downscaled GCM. Each set of 3 panels shows the evaluation for one model, with the error calculated as the predicted minus actual snowfall loss. The top row shows the average over all 12 leave-one-out experiments, but with the average of the absolute errors.

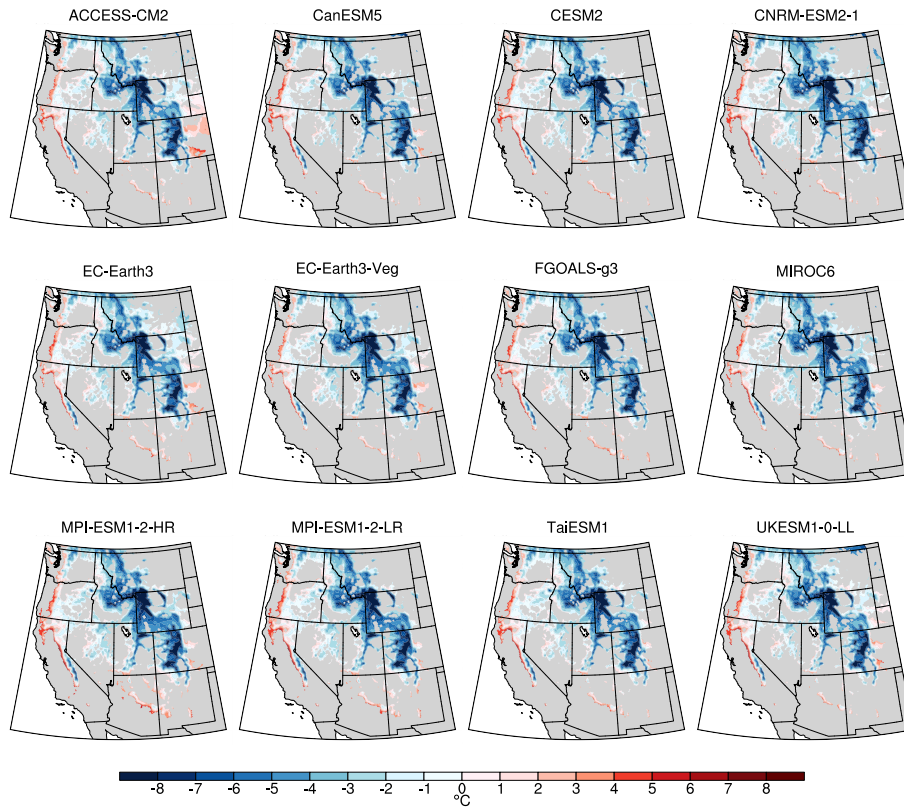


Figure S6: Mean historical 2-m temperature in NDJFMA in each downscaled GCM.

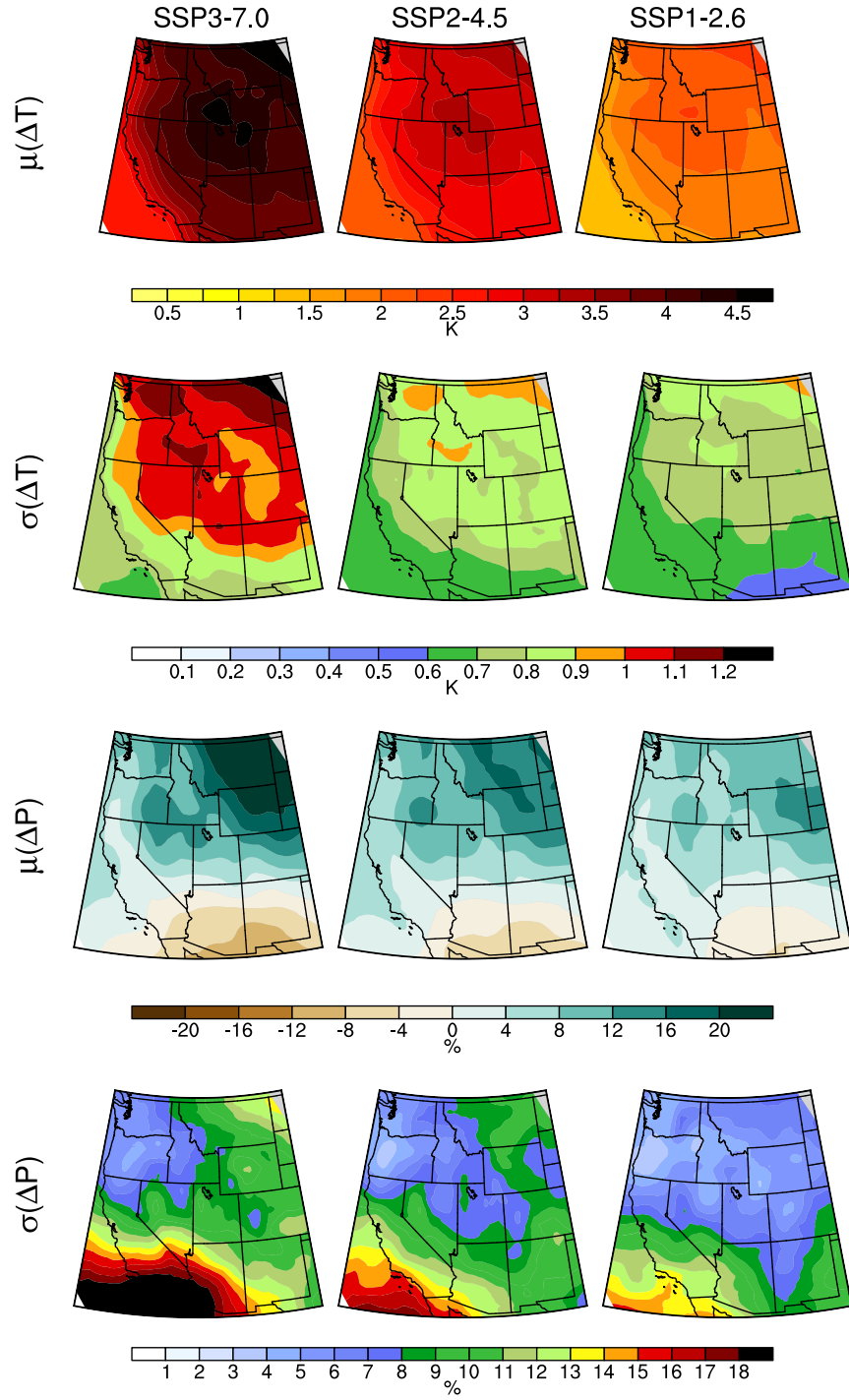


Figure S7: Annual ΔT and NDJFMA $\Delta P/P$ in all 34 raw CMIP6 GCMs. Shown as the multi-model mean (first and third rows) and standard deviation (second and fourth rows). Shown for SSP3-7.0, SSP2-4.5, and SSP1-2.6 in first, second, and third columns.

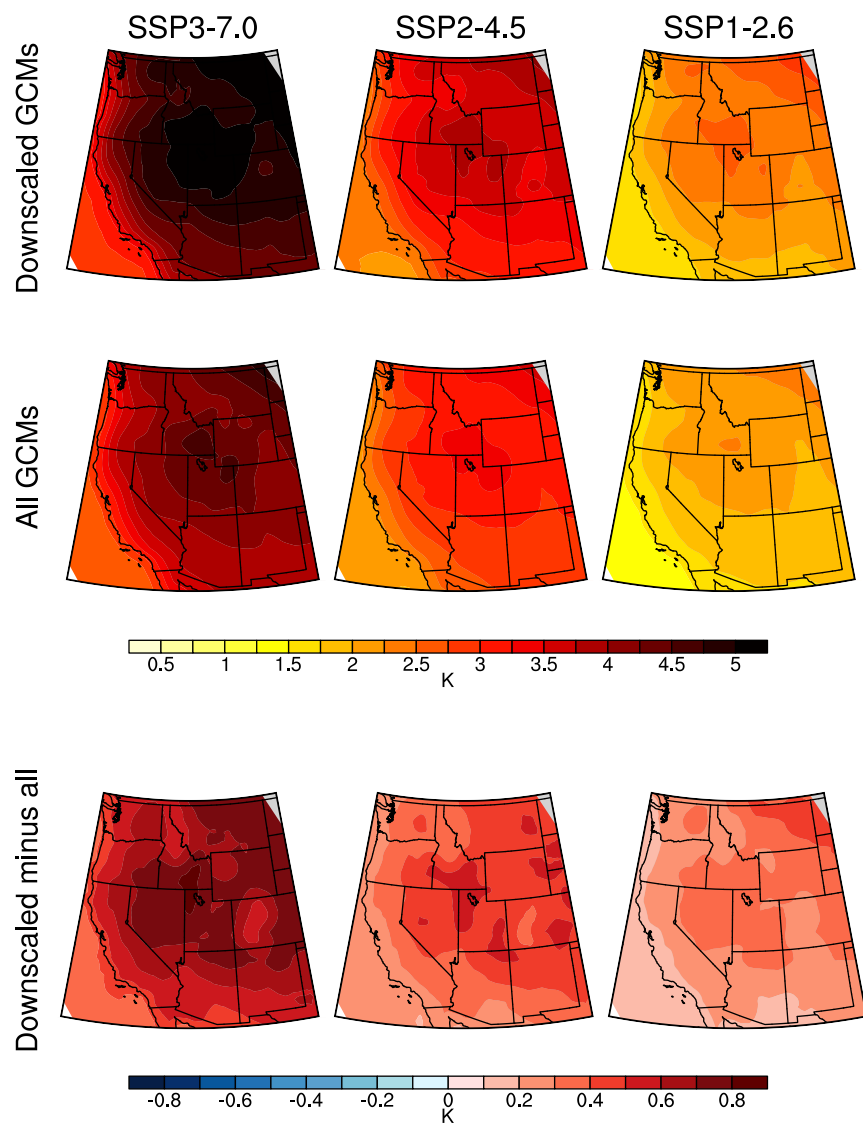


Figure S8: Annual ΔT in raw GCMs under the three scenarios, comparing the mean of the 12 GCMs that were dynamically downscaled (top row) and the mean of all 34 CMIP6 GCMs (second row), with the difference on the bottom row.

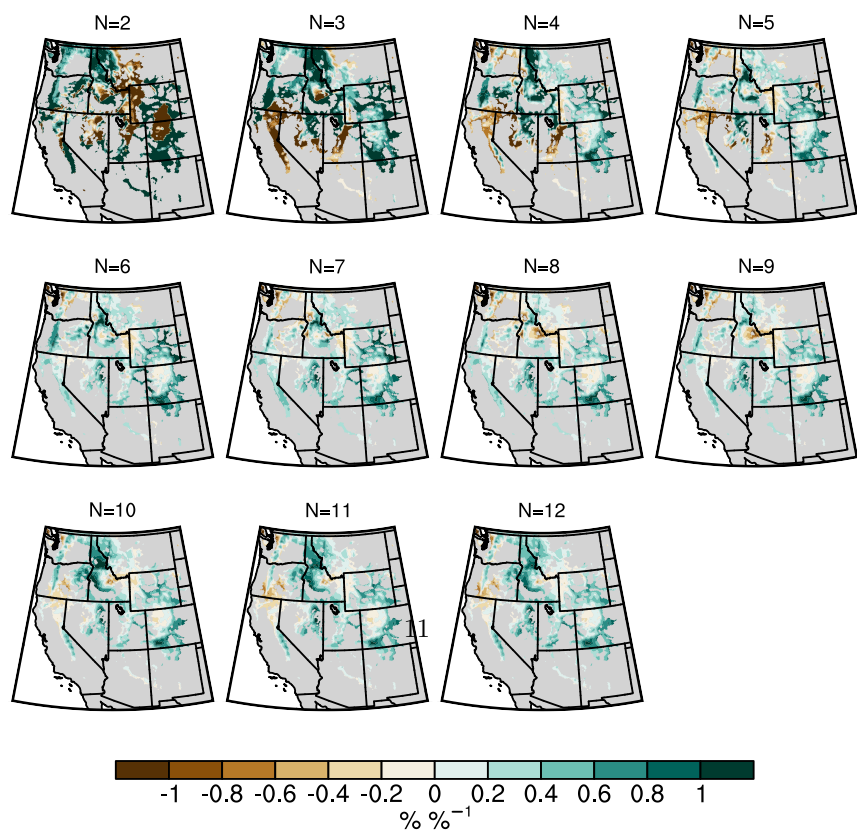
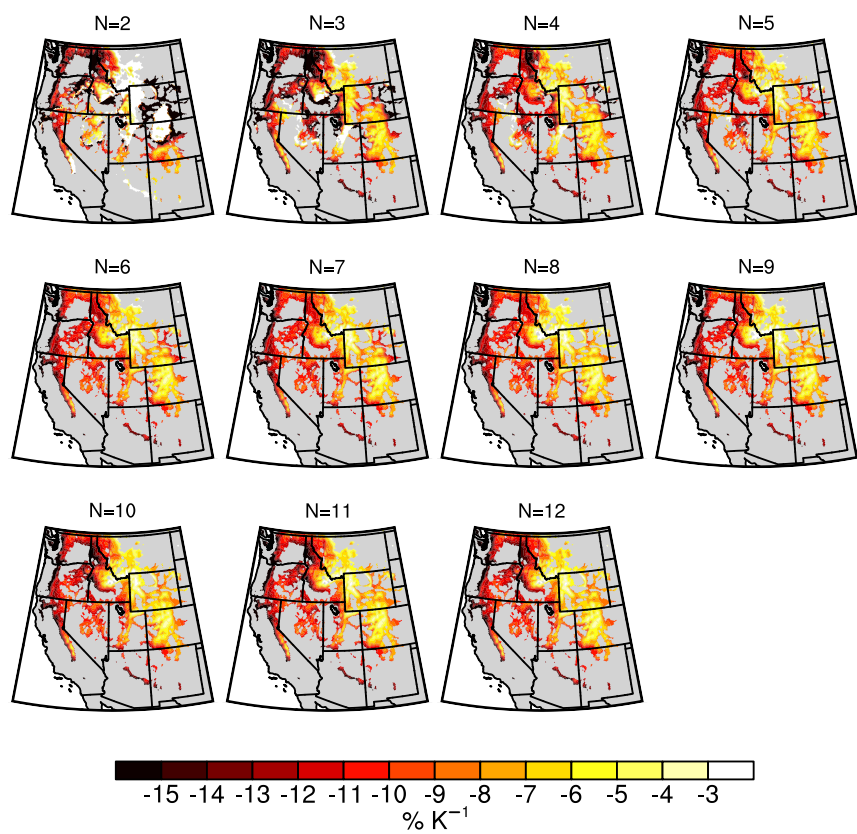


Figure S9: The coefficients (Equation 3) for ΔT_{GCM} (top) and $(\Delta P/P)_{GCM}$ (bottom) calculated from a progressively increasing number of raw GCM/downscaled GCM pairs. Thus, the coefficients for $N=12$ are equivalent to those in Figs. 4d,e, i.e., using the full downscaled ensemble. The order in which the GCMs are added to the regression is randomized.

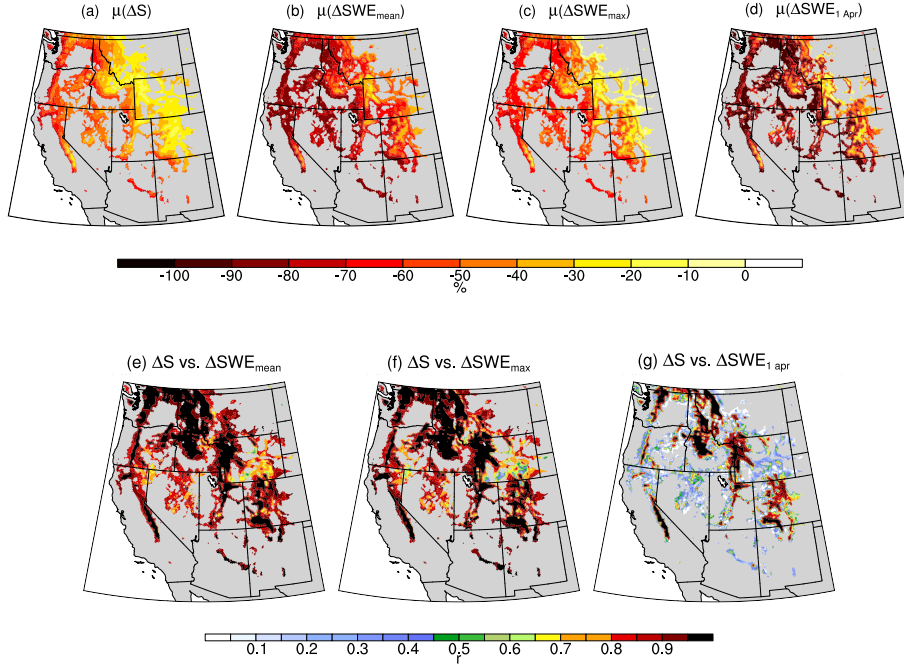


Figure S10: Comparison of (a) $\Delta S/S$ with various metrics of fractional SWE loss: (b) annual-mean SWE; (c) annual-maximum SWE; (d) April-1st SWE. All are shown as the mean of the downscaled ensemble. Bottom panels show the inter-model correlation between $\Delta S/S$ and the given metrics of fractional SWE loss.